US006396840B1

(12) **United States Patent**
Rose et al.

(10) **Patent No.: US 6,396,840 B1**
(45) **Date of Patent: *May 28, 2002**

(54) **METHOD, INTERFACE AND SYSTEM FOR CONNECTING COMMUNICATION TRAFFIC ACROSS AN INTERMEDIATE NETWORK**

(75) Inventors: **Desne Jean Rose**, St Albans; **Roy Harold Mauger**, Radlett, both of (GB)

(73) Assignee: **Nortel Networks Limited**, St. Laurent (CA)

(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/089,796**

(22) Filed: **Jun. 3, 1998**

(30) **Foreign Application Priority Data**

Jun. 6, 1997 (GB) 9711788

(51) **Int. Cl.**[7] **H04J 3/02**
(52) **U.S. Cl.** **370/401**
(58) **Field of Search** 370/351, 352, 370/401, 400, 389, 399, 397, 396, 395, 465, 466, 468, 335, 537, 503, 229, 412, 516, 460, 252–255, 353, 360, 364, 394, 406, 409, 467, 469, 471, 474–476; 379/14, 16, 95.15, 93.14, 93.07, 93.05, 93.31, 219, 220, 225, 232, 240, 242, 229, 230, 231

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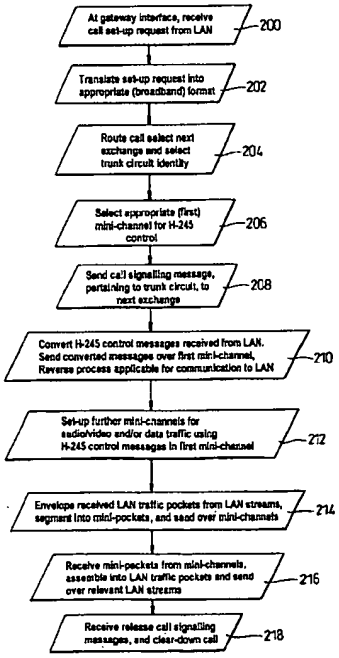
Primary Examiner—Dang Ton
(74) *Attorney, Agent, or Firm*—Lee, Mann, Smith, McWilliams Sweeney & Ohlson

(57) **ABSTRACT**

Interconnection of a multimedia terminal **(110)** of a narrowband, LAN-type network **(10)** to an exchange **(118)** and thence to an end-point **(119)** is orchestrated through an intermediate network **(142)**, as shown in FIG. **5**. A route **(115)** to the exchange **(118)** is initially established by a call handler **(116)** in responsive to a called party number of the end-point, before a connection supervisor **(120)**, coupled to the call handler **(116)**, sets up a control channel across the intermediate network **(142)**. The control channel supports the communication of control messages between the multimedia terminal **(110)** and the end-point **(119)**, which control messages are intercepted and interpreted by the connection supervisor **(120)**. The connection supervisor **(120)** then establishes media paths through the intermediate network **(142)** dependent upon types of control message sent across the control channel, which media paths are used to transfer traffic components across the intermediate network.

24 Claims, 6 Drawing Sheets



US005953331A

United States Patent [19]

Duncan et al.

[11] Patent Number: 5,953,331

[45] Date of Patent: Sep. 14, 1999

[54] **WIRELESS PACKET SYSTEM FOR EFFICIENT WIDE AREA BANDWIDTH UTILIZATION**

[75] Inventors: **Thomas Duncan**, Naperville, Ill.; **Richard Dennis Gitlin**, Little Silver, N.J.; **Thomas F. La Porta**, Thornwood, N.Y.; **Kazutaka Murakami**, Freehold, N.J.; **Krishan Kumar Sabnani**, Westfield, N.J.; **Anil S. Sawkar**, Somerset, N.J.; **David E. Smith**, Elmhurst, Ill.

[73] Assignee: **Lucent Technologies Inc.**, Murray Hill, N.J.

[21] Appl. No.: **08/925,876**

[22] Filed: **Sep. 9, 1997**

[51] **Int. Cl.**[6] **H04L 12/20**

[52] **U.S. Cl.** **370/352**; 370/465; 370/545

[58] **Field of Search** 370/328, 338, 370/465, 467, 468, 477, 391, 545, 352, 354, 358; 455/500, 561, 465, 557

[56] **References Cited**

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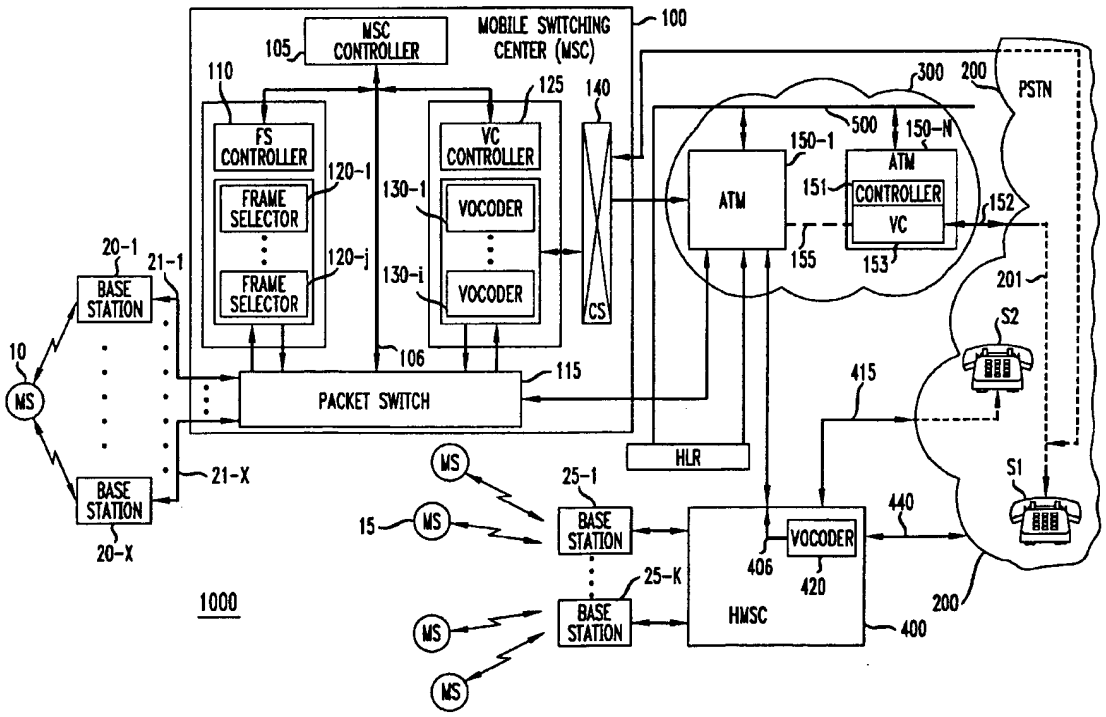
Primary Examiner—Chau Nguyen
Assistant Examiner—Kenneth Vanderpuye
Attorney, Agent, or Firm—Thomas J. Bean

[57] **ABSTRACT**

A telecommunications system is arranged to efficiently route digital information from a mobile network to a Public Switched Telephone Network (PSTN) and vice versa by interposing a packet network between the mobile network and PSTN so that digital information originating from the wireless network at a first data rate may be forwarded over the packet network at that rate and then sent over a direct connection from the packet network to the PSTN at a second data rate expected by the PSTN. In this way the conversion of the digital information from the first to the second data rate is performed only when needed, i.e., at the ATM switch connected to the PSTN.

17 Claims, 9 Drawing Sheets



US005724352A

United States Patent [19]

Cloonan et al.

[11] Patent Number: 5,724,352

[45] Date of Patent: *Mar. 3, 1998

[54] **TERABIT PER SECOND PACKET SWITCH HAVING ASSIGNABLE MULTIPLE PACKET LOSS PROBABILITIES**

[75] Inventors: **Thomas Jay Cloonan**, Downers Grove; **Gaylord Warner Richards**, Lisle, both of Ill.

[73] Assignee: **Lucent Technologies Inc.**, Murray Hill, N.J.

[*] Notice: The term of this patent shall not extend beyond the expiration date of Pat. No. 5,544,160.

[21] Appl. No.: **522,209**

[22] Filed: **Aug. 31, 1995**

[51] **Int. Cl.**[6] **H04L 12/54**

[52] **U.S. Cl.** **370/395**; 370/413; 370/419; 340/825.5

[58] **Field of Search** 370/252, 253, 370/229, 230, 231, 235, 238, 395, 396, 397, 398, 399, 412, 413–419, 420; 340/825.5, 825.51, 825.52

[56] **References Cited**

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4,993,016	2/1991	Richards	370/351
5,040,173	8/1991	Richards	370/351
5,077,483	12/1991	Cloonan et al.	359/135
5,122,892	6/1992	Cloonan et al.	359/117
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W. E. Stephens et al., "Terabit-per-Second Throughput Switches for Broadband Central Offices: An Overview", *IEEE LCS*, Nov. 1990, pp. 20–26.

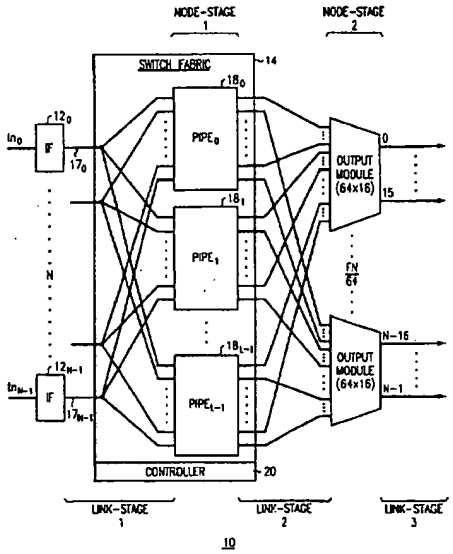
K.Y. Eng et al., "A Growable Packet (ATM) Switch Architecture: Design Principles and Applications", *IEEE Transactions on Communications*, vol. 40, No. 2, Feb. 1992, pp. 423–430.

Primary Examiner—Benedict V. Safourek
Assistant Examiner—Seema S. Rao
Attorney, Agent, or Firm—Jack R. Penrod

[57] **ABSTRACT**

A physically realizable one terabit or more ATM packet switch that has a large number of input interfaces connected to a single stage switching fabric which is in turn connected to a number of output modules, generally according to the growable packet switch architecture. This ATM packet switch is different from other growable packet switches in that it has a single stage switch fabric controlled by an out-of-band controller, yet it has significantly reduced complexity with respect to comparably sized electronic crossbar switches or their isomorphs. The out-of-band controller has multiple priority levels in order to provide high priority users with a near certainty that their packets will be successfully routed, while delivering an acceptably low packet or cell loss probability to users at the lowest priority level.

21 Claims, 17 Drawing Sheets



US005724349A

United States Patent [19]

Cloonan et al.

[11] Patent Number: 5,724,349

[45] Date of Patent: *Mar. 3, 1998

[54] **TERABIT PER SECOND ATM PACKET SWITCH HAVING OUT-OF-BAND CONTROL WITH MULTI CASTING**

[75] Inventors: **Thomas Jay Cloonan**, Downers Grove; **Gaylord Warner Richards**, Lisle, both of Ill.

[73] Assignee: **Lucent Technologies Inc.**, Murray Hill, N.J.

[*] Notice: The term of this patent shall not extend beyond the expiration date of Pat. No. 5,544,160 and 5,642,349.

[21] Appl. No.: **521,676**

[22] Filed: **Aug. 31, 1995**

[51] **Int. Cl.**[6] **H04L 12/56**

[52] **U.S. Cl.** **370/390**; 370/395; 370/427

[58] **Field of Search** 370/252, 253, 370/229, 231, 235, 238, 395–399, 411, 412, 413–420, 427, 351, 354.355, 358, 359, 360, 362, 363, 390; 340/825.5, 825.51, 825.52

[56] **References Cited**

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4,872,158	10/1989	Richards	370/380
4,988,993	1/1991	Hwang et al.	340/825.8
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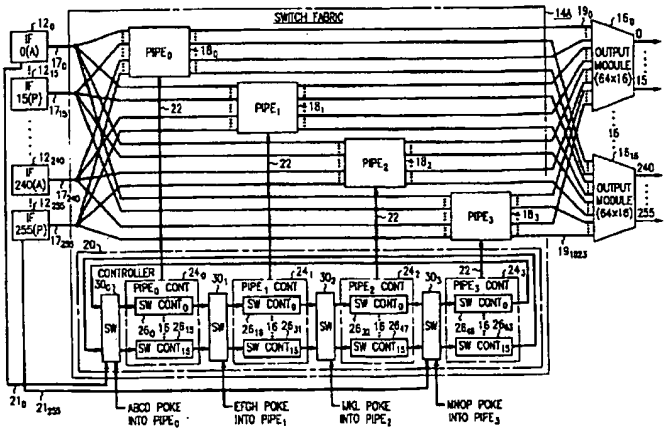
H. Jonathan Chao and Jin-Soo Park, "Abacus switch: a new scalable multicast ATM switch" Feb. 13, 1996.

Primary Examiner—Benedict V. Safourek
Assistant Examiner—Seema S. Rao
Attorney, Agent, or Firm—Jack R. Penrod

[57] **ABSTRACT**

An out-of-band controller for a large packet switch which is distributed throughout partitions or pipes of the packet switch. Thus, the out-of-band controller is divided into multiple pipe controllers. These pipe controllers are connected and operated in a ring such that each pipe controller is with a respective fraction of the input path requests for packets. The requests are processed concurrently and any request that is not fulfilled in one pipe controller is offered to up to three subsequent pipe controllers to hunt a path for the awaiting packets. The controller, by using up to four levels of parallelism, can hunt paths and set up connections for 256 or more input ATM packet lines in normal monocast mode, thus providing a throughput of 1 terabit per second or more. A distributed controller design makes such tremendous aggregate switching speeds possible. The same general distributed controller design can also provide pipe hunting for a special packet operation called multicasting, in which one packet from one input line is transmitted to many or even all output lines. As can be appreciated, multicasting can monopolize system assets to the detriment of other ATM packets, so some multicasting may be made during special packet cycles when primarily multicasting packets will be carried. One such special packet cycle might occur at system initialization.

17 Claims, 17 Drawing Sheets



US005642349A

United States Patent [19]

Cloonan et al.

[11] Patent Number: 5,642,349

[45] Date of Patent: Jun. 24, 1997

[54] **TERABIT PER SECOND ATM PACKET SWITCH HAVING DISTRIBUTED OUT-OF-BAND CONTROL**

[75] Inventors: **Thomas Jay Cloonan**, Downers Grove; **Gaylord Warner Richards**, Lisle, both of Ill.

[73] Assignee: **Lucent Technologies Inc.**, Murray Hill, N.J.

[21] Appl. No.: **367,489**

[22] Filed: **Dec. 30, 1994**

[51] **Int. Cl.**[6] **H04L 12/56**

[52] **U.S. Cl.** **370/395**; 370/427

[58] **Field of Search** 370/60, 17, 60.1, 370/94.1, 94.2, 58.1, 58.3, 54, 58.2, 63, 64, 65.5, 65, 66, 67, 68, 110.1, 85.13, 85.4, 85.5, 85.12, 85.14; 359/117, 139; 340/225.8, 825.79

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4,686,669	8/1987	Chang	370/54
4,872,158	10/1989	Richards	370/58
4,988,993	1/1991	Hwang et al.	340/825.8
4,993,016	2/1991	Richards	370/54
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W. E. Stephens et al., "Terabit-per-Second Throughput Switches for Broadband Central Offices: An Overview", *IEEE LCS*, Nov. 1990, pp. 20–26.

K. Y. Eng et al., "A Growable Packet (ATM) Switch Architecture: Design Principles and Applications", *IEEE Transactions on Communications*, vol. 40, No. 2, Feb. 1992, pp. 423–430.

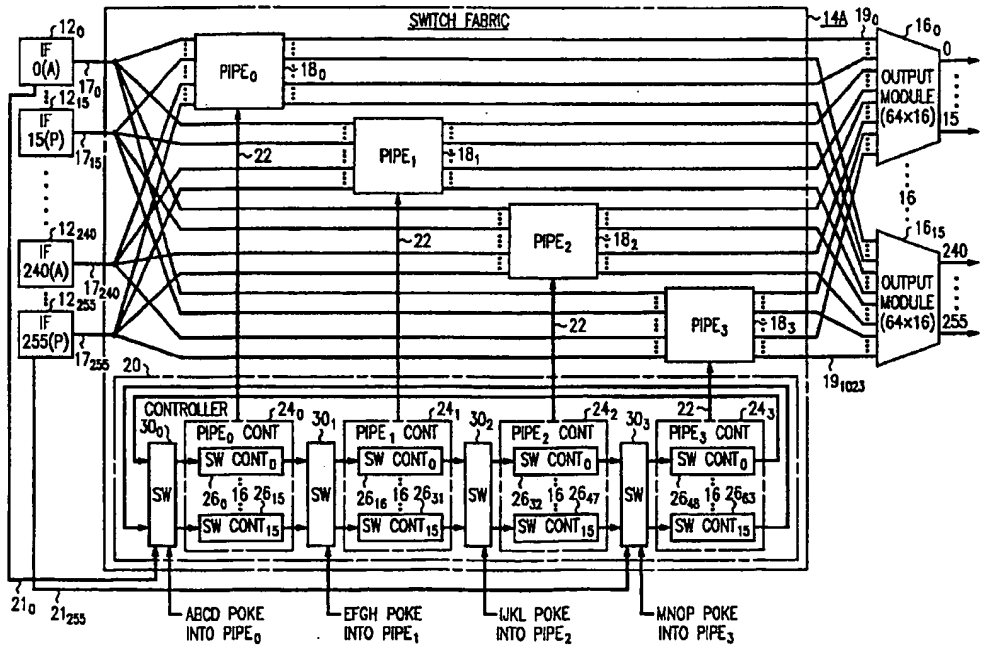
Primary Examiner—Dang Ton

Attorney, Agent, or Firm—Jack R. Penrod

[57] **ABSTRACT**

An out-of-band controller for a large packet switch which is distributed throughout partitions or pipes of the packet switch. Thus, the out-of-band controller is divided into multiple pipe controllers. These pipe controllers are connected and operated in a ring such that each pipe controller is with a respective fraction of the input path requests for packets. The requests are processed concurrently and any request that is not fulfilled in one pipe controller is offered to up to three subsequent pipe controllers to hunt a path for the awaiting packets. The controller, by using up to four levels of parallelism, can hunt paths and set up connections for 256 or more input ATM packet lines, thus providing a throughput of 1 terabit per second or more. By distributing the controller both tremendous aggregate switching speeds may be attained without resort to exotic semiconductor technologies.

14 Claims, 18 Drawing Sheets



US005544160A

United States Patent [19]

Cloonan et al.

[11] **Patent Number: 5,544,160**

[45] **Date of Patent: Aug. 6, 1996**

[54] **TERABIT PER SECOND PACKET SWITCH**

[75] Inventors: **Thomas J. Cloonan**, Downers Grove; **Gaylord W. Richards**, Lisle, both of Ill.

[73] Assignee: **AT&T Corp.**, Murray Hill, N.J.

[21] Appl. No.: **366,704**

[22] Filed: **Dec. 30, 1994**

[51] **Int. Cl.**[6] **H04L 12/54**

[52] **U.S. Cl.** **370/54**; 370/58.2; 370/60.1; 370/61; 370/85.6; 370/94.2; 340/825.5

[58] **Field of Search** 370/54, 58, 2, 370/60, 60.1, 85.6, 94.1, 94.2; 340/825.5, 825.51

[56] **References Cited**

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4,035,584	7/1977	Lurtz	179/15
4,592,048	5/1986	Beckner et al.	370/60
4,872,158	10/1989	Richards	370/58.1
4,988,933	1/1991	Hwang et al.	340/825
4,993,016	2/1991	Richards	370/54
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W. E. Stephens et al., "Terabit-per-Second Throughput Switches for Broadband Central Offices: An Overview", *IEEE LCS*, Nov. 1990, pp. 20–26.

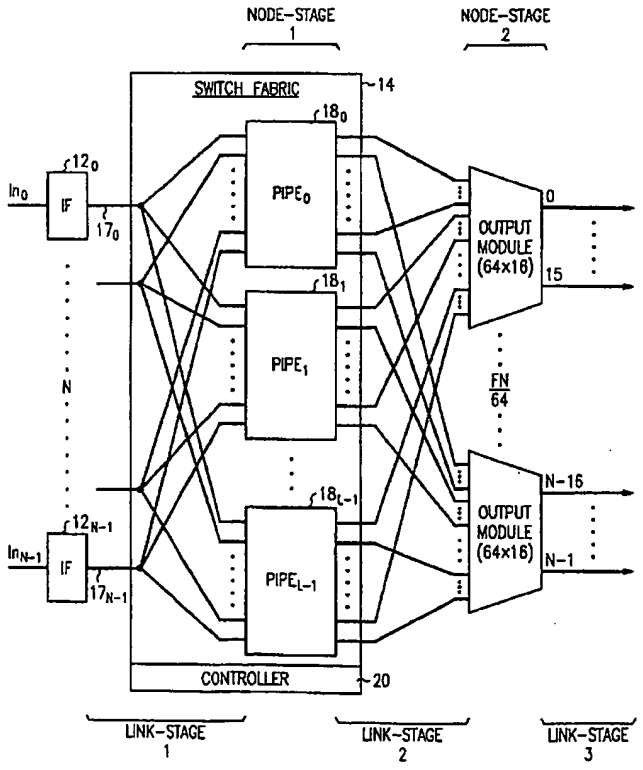
K. Y. Eng et al., "A Growable Packet (ATM) Switch Architecture: Design Principles and Applications", *IEEE Transactions on Communications*, vol. 40, No. 2, Feb. 1992, pp. 423–430.

Primary Examiner—Douglas W. Olms
Assistant Examiner—Russell W. Blum
Attorney, Agent, or Firm—Jack R. Penrod

[57] **ABSTRACT**

A physically realizable one terabit or more ATM packet switch that has a large number of input interfaces connected to a single stage switching fabric which is in turn connected to a number of output modules, generally according to the growable packet switch architecture. This ATM packet switch is different from other growable packet switches in that it has a single stage switch fabric controlled by an out-of-band controller, yet it has significantly reduced complexity with respect to comparably sized electronic crossbar switches or their isomorphs.

26 Claims, 16 Drawing Sheets



US005537403A

United States Patent [19]

Cloonan et al.

[11] Patent Number: 5,537,403

[45] Date of Patent: Jul. 16, 1996

[54] **TERABIT PER SECOND PACKET SWITCH HAVING DISTRIBUTED OUT-OF-BAND CONTROL OF CIRCUIT AND PACKET SWITCHING COMMUNICATIONS**

[75] Inventors: **Thomas J. Cloonan**, Downers Grove; **Gaylord W. Richards**, Lisle, both of Ill.

[73] Assignee: **AT&T Corp.**, Murray Hill, N.J.

[21] Appl. No.: **366,708**

[22] Filed: **Dec. 30, 1994**

[51] **Int. Cl.**[6] **H04L 12/56**

[52] **U.S. Cl.** **370/60.1**; 370/54

[58] **Field of Search** 370/60, 60.1, 61, 370/94.1, 94.2, 63, 64, 65, 65.5, 16, 58.2, 58.3, 53, 55, 56, 54; 340/827; 395/181

[56] **References Cited**

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W. E. Stephens et al. "Terabit-per-Second Throughput Switches For Broadband Central Offices: An overview", *IEEE LCS*, Nov. 1990, pp. 20–26.

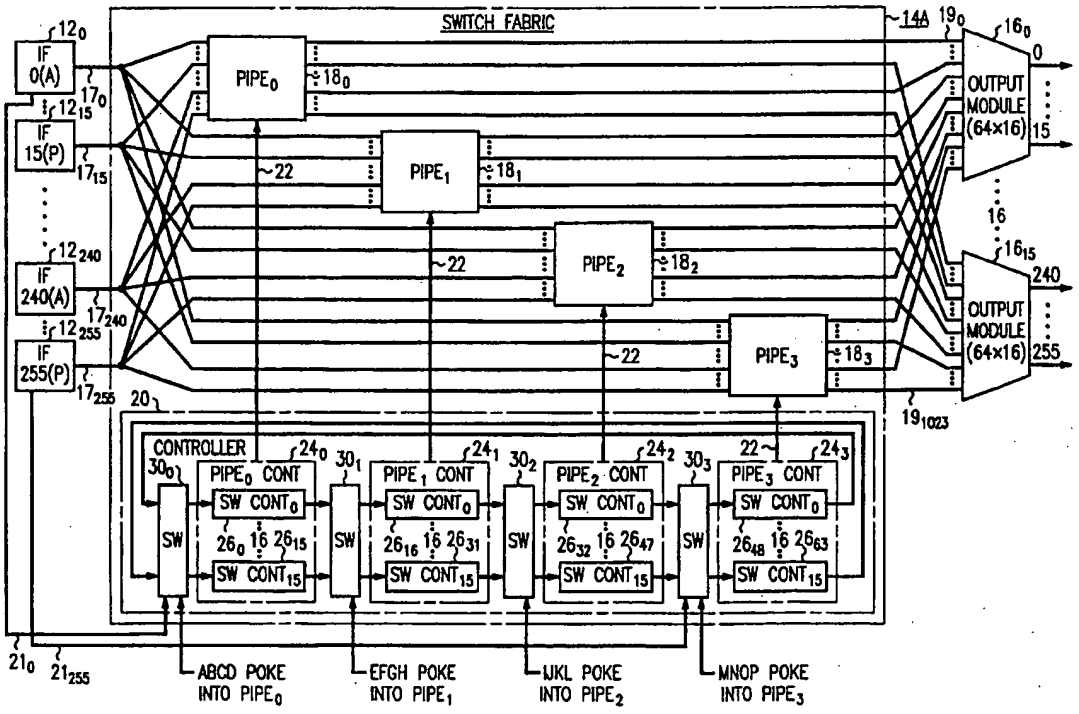
K. Y. Eng et al. "A Growable Packet (ATM) Switch Architecture: Design Principles and Applications", *IEEE Transactions on Communications*, vol. 40, No. 2, Feb. 1992, pp. 423–430.

Primary Examiner—Douglas W. Olms
Assistant Examiner—Dang Ton
Attorney, Agent, or Firm—Jack R. Penrod

[57] **ABSTRACT**

A telecommunications switch which has a central switch fabric made up of multiple crossbars that can be used to switch either circuit switched or packet switch communications as long as appropriate input and output interfaces and controllers are provided. Thus, a large, high throughput telecommunications switch is provided where the expensive switch fabric core can remain the same and the interfaces and control cards changed as the relative demands for circuit switched communications and packet switched communications, such as ATM, evolve. Besides being flexible, this switch may also be fault tolerant.

11 Claims, 19 Drawing Sheets



US 20020181670A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2002/0181670 A1

MYERS et al. (43) Pub. Date: Dec. 5, 2002

(54) TELEPHONY CALL CONTROL USING A DATA NETWORK AND A GRAPHICAL USER INTERFACE AND EXCHANGING DATAGRAMS BETWEEN PARTIES TO A TELEPHONE CALL

(76) Inventors: JOHN C. MYERS, ONTARIO (CA); BRIAN CRUICKSHANK, ONTARIO (CA)

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DALLAS, TX 75380 (US)

(*) Notice: This is a publication of a continued prosecution application (CPA) filed under 37 CFR 1.53(d).

(21) Appl. No.: 09/220,860

(22) Filed: Dec. 28, 1998

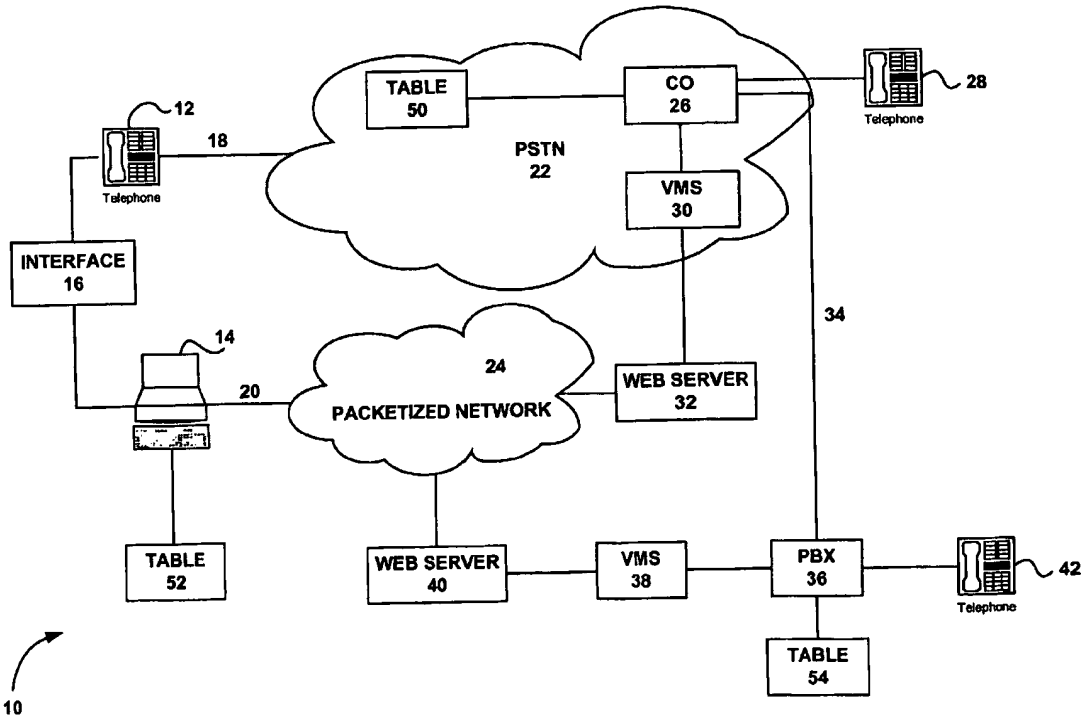
Publication Classification

(51) Int. Cl.[7] H04M 1/64; H04M 11/00; G06F 15/16

(52) U.S. Cl. 379/88.13; 709/250

(57) ABSTRACT

In a communications network, a method and apparatus are disclosed for using a graphical user interface for telephony call control. A method is also disclosed for sending a datagram from a called party to a calling party. Call control of a call is diverted to a voice-mail system. The IP address of the caller is determined. The IP address of the caller is determined by either a search on a look-up table or from a voice over Internet call set up message. Call control information, or a datagram is sent to the caller. In the case of call control information, the caller inputs call control commands which are received by the voice mail system. The invention provides an easier method and apparatus to navigate voice-mail menus and reduces the problem of "voice-mail jail".



US006292473B1

(12) **United States Patent**
Duske, Jr. et al.

(10) **Patent No.: US 6,292,473 B1**
(45) **Date of Patent: Sep. 18, 2001**

(54) **MOBILE COMMUNICATIONS TERMINAL FOR SATELLITE COMMUNICATIONS SYSTEM**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/093,095**

(22) Filed: **Jun. 8, 1998**

Related U.S. Application Data

(63) Continuation of application No. PCT/US96/19905, filed on Dec. 6, 1996.
(60) Provisional application No. 60/011,158, filed on Dec. 8, 1995.

(51) **Int. Cl.**[7] **H04H 1/00**; H04J 3/24
(52) **U.S. Cl.** **370/316**; 370/328; 370/339; 370/349; 455/412
(58) **Field of Search** 370/315, 316, 370/327, 328, 339, 349; 455/406, 405, 345, 227, 228, 410, 412, 413

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(57) **ABSTRACT**

A mobile communications system transporting messages between mobile terminals and a central control center using a satellite communications system. The central control center and the mobile terminals each store a plurality of message display forms each having a form identifier and a predetermined display format. The message display forms are selected as templates for generating user messages including message data supplied at the originating station. The satellite messages transmit the user message by transmitting the message data and the form identifier of the corresponding selected message display form. The receiving station, upon receiving the satellite message, accesses the message display form from memory in response to the supplied form identifier, and combines the accessed message display form with the message data to recreate the user message. The mobile terminals are designed as low-cost data terminals requiring a minimum amount of memory. The mobile terminals include a satellite transceiver, a graphic user interface providing a display and accepting key inputs from the user, and a software system including an application layer providing all messaging functions for the user and a middleware layer controlling transport of message between the application layer and the satellite transceiver. The application layer operates as an event-based state machine, and includes an event handler that controls the application layers operations in accordance with the processing capacity of the middleware layer.

15 Claims, 26 Drawing Sheets